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Let's Get Graphic: The Integration of Visual Representations to Demonstrate Learning

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Author Biography

Dr. Courtneay Kelly is an assistant professor of in the Language and Literacy Learning program in the Education Department at the University of Lynchburg. Prior to her role at the University of Lynchburg, she was an assistant professor of Elementary Education for four years at Longwood University. She has had over twenty years of teaching experience, having served as an assistant professor of education, an elementary school classroom teacher, a literacy and RtI specialist, and a research assistant.Sheis a "Double 'Hoo" University of Virginia graduate, having earned both her M.Ed. in Reading Education in 2010 and her Ed.D. in Curriculum & Instruction in 2018. As an undergraduate, she attended Mary Washington College, where she earned her B.A. in English and her PreK-6 teaching licensure. Her research focuses on differentiation through the use of the Universal Design for Learning framework, impactful literacy practices, teacher perceptions of differentiation in literacy, and the development of school-based literacy leaders.

Abstract

Students derive meaning from knowledge that is presented to them in various ways. An instructor may present information through different modalities, though direct verbal instruction is the mode most often employed (Beesley & Apthorp, 2010). Research indicates that, when information is constructed through the use of visual representations, students gain deeper and more enduring understanding of the content (Jewitt, 2008; Kress, 1997). This article provides an explanation and definition of nonlinguistic and linguistic visual representations, a review of what research indicates in the integration of them, and examples of the inclusion of concept-based visual representations in a college course that focuses on training pre-service teachers in literacy pedagogy.

What are Nonlinguistic Representations?

Visual representations are based on the Dual Coding Theory of information storage, which suggests that knowledge is stored both in linguistic and nonlinguistic forms (Paivio, 1990; Sadoski & Paivio, 2013). Linguistic knowledge is semantic in nature and is focused on the storage of words and language, while nonlinguistic knowledge refers to the storage of information using images, graphics, and physical sensations (Sadoski & Paivio, 2013). While research indicates that educators primarily lean on linguistic means of presenting instruction (Beesley & Apthorp, 2010; Paivio, 1990; Schmidt & Marzano, 2015), students require a balance of linguistic and nonlinguistic learning experiences in order for knowledge to stay in their long-term memory and to provide more accurate recall. Students are often left to their own devices to generate nonlinguistic visual representations, which calls for a need for educators to take the lead on guiding students into creating these images and graphics to support knowledge retention.

What Does Research Have to Say About Visual Representations?

Today's students have plenty of opportunities to process information linguistically. They listen to teachers introduce content and they read and write about information that has been presented. Students have fewer opportunities in school to process information non-linguistically, though educators have understood for decades that the mind processes incoming information in these the two primary forms of linguistic and imagery (Paivio, 1990; Schmidt & Marzano, 2015). The more learners use both modes of storing knowledge, the better able they are to have sustained learning and quicker recall of information. Studies indicate that educators often rely heavily on linguistic instruction, or instruction that is presented verbally or in texts (Beesley & Apthorp, 2010; Paivio, 1990; Schmidt & Marzano, 2015). Nonlinguistic learning is the imagery mode of representation, primarily taking the form of mental pictures, graphics or images, and physical feelings, sensations, or experiences. Nonlinguistic strategies require students to generate a representation of new information that does not necessarily rely on language. Haystead and Marzano (2009) analyzed the outcomes of 129 studies in which teachers integrated nonlinguistic

representations and found there to be a strong direct correlation between the incorporation of nonlinguistic representations and quicker, more accurate recall of learned information.

The goal of the integration of visual representations to express learning is to guide students into creating conceptual mental images and constructions (Marzano, Pickering, & Pollock, 2001; Sadoski & Paivio, 2013), and there are many ways in which this can be accomplished. Marzano, Pickering, & Polluck (2001) conducted extensive research on the topic of nonlinguistic and linguistic representations, which indicated that the following activities can be incorporated in order to lead students to the development of mental visual representations-- creation of graphic representations, building of physical models, generation of mental pictures, drawing, and engaging in physical activity.

One example of how students may integrate visual representations to elaborate on current knowledge is the construction of mental images of what an abstract concept would look like in concrete form. This elaboration of knowledge allows for deeper learning and faster recall (Pressley, Symons, McDaniel, Snyder, & Turnure, 1988). The powerful learning of students' creation of images or graphics that depict concepts and knowledge is enhanced even more by asking students to explain and justify them (Pressley, Symons, McDaniel, Snyder, & Turnure, 1988), which offers students the opportunity to blend nonlinguistic images with linguistic explanations.

Literature that focuses on teaching and learning underscores the importance of developing higher-order thinking skills (Bransford et al., 2004; Ambrose et al., 2010). For deep learning that can result in long-lasting, transferrable knowledge to occur, it is necessary to develop higher-order skills that include an understanding of the basic ideas/concepts within the context of a conceptual framework, organized in a fluid structure that can accommodate new information/ideas or concepts (Bransford et al., 2004; Dubas & Toledo, 2016). This is the only type of learning that can lead to greater generalization or transfer of knowledge to other domains (Bransford et al., 2004). Therefore, the design of learning opportunities needs to specifically target visual representations and integrate them with intention.

The Integration of Nonlinguistic and Linguistic Representations in Classrooms

Commonly integrated examples of nonlinguistic visual representations in classrooms are the creation of physical models, generation of mental images, photos, conceptual maps and frameworks, and kinesthetic activities. For example, when teaching elementary science students about the atom, a popular activity is the creation of an atomic model using 3-D materials. This type of tactile construction, in which written linguistics do not necessarily play a role, has been proven to lead to deeper learning that endures (Haystead & Marzano, 2009). Another instructional strategy that supports nonlinguistic learning is when students are asked to visualize while reading, leading them to the generation of ideas and mental images that have been proven to support reading comprehension (De Koning & van der Shoot, 2013). Nonlinguistic representations are designed to conceptually connect or elaborate upon previously learned information. They are often incorporated as a tool to process and represent knowledge.

When students are asked to integrate words with visual representations, they are generating linguistic representations. A common example of a linguistic visual representation is the use of graphic organizers. Graphic organizers typically combine the linguistic mode of representation with the nonlinguistic mode by connecting conceptual words and phrases with boxes, symbols, arrows, and pictures that represent links and relationships. Graphic organizers are used to help students identify patterns, processes, and generalizations. Consider the above example of the atomic model. If a student were to add brief written descriptions that reviewed each component of the model, the creation would become a visual representation that blends the nonlinguistic form of the model with the linguistic descriptors.

Visual representations can be used to help learners organize their knowledge in meaningful ways by identifying how related topics connect and finding patterns and conceptual linkages

(Lehrer & Chazen, 1998; National Council of Teachers of Mathematics (NCTM), 2000). Explicitly engaging students in the creation of visual representations stimulates and increases attention to and interpretation of new knowledge. The goal is to produce visual representations of knowledge in the minds of students (Marzano, Pickering, & Pollock, 2001) by giving them the opportunity and time to create and construct models, thoughts, or images that indicate understanding of conceptual foundations and linkages.

Visual Representations in a Literacy Education Course

As a professor of undergraduate and graduate students in the education program, training them in literacy pedagogies, I have found great value in the integration of visual representations in my courses. Because literacy concepts are interlinked and complex, it is necessary for students to grapple with them, determining connections and deciding which concepts are foundational. The robust literature on scaffolding student learning (Ambrose et al., 2010; Simons and Klein, 2007; Cooper et al., 2012; Eddy and Hogan, 2014; Clarke et al., 2005; Vygotsky, 1978), or providing appropriate levels of instructional support as needed, underlies my approach to the incorporation of visual representations.

The integration of visual representations in my courses is twofold. First, it ensures that students fully understand the concepts with which they are presented, as they are tasked with designing a visual or graphic depiction of the ways in which complex literacy concepts connect. This understanding is demonstrated when students explain their visual representations, justifying their choices. Secondly, as a teacher of teachers, it is my job to prepare my students to employ higher level thinking strategies with their future students. The inclusion of nonlinguistic and linguistic visual representations in my coursework introduces my education students to a higher-order metacognitive skill that they will later be able to incorporate into their own classrooms,

with students of all ages. The below four images are examples of how my university undergraduate and graduate education students have used visual representations to make mental connections of the components of effective literacy instruction.

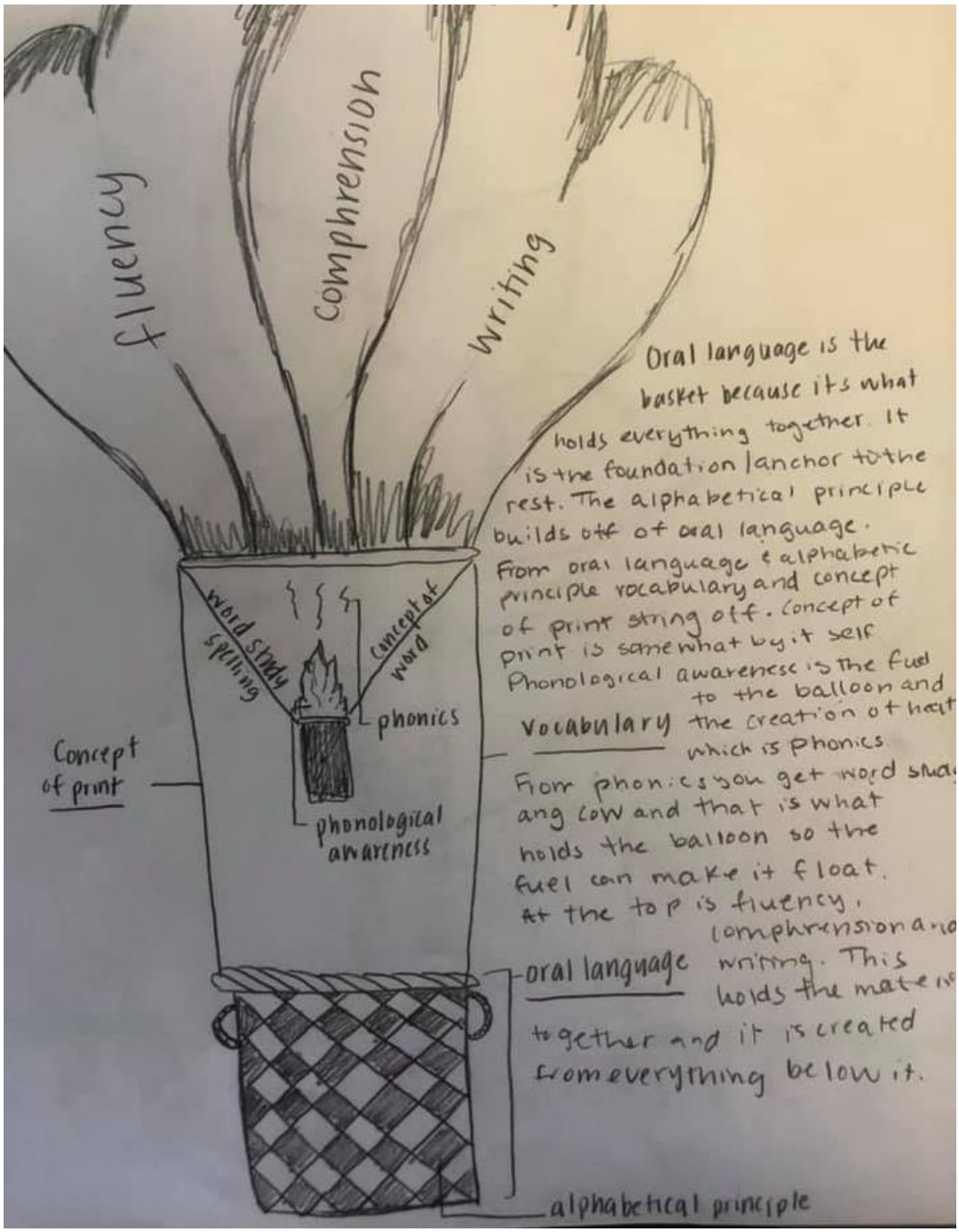


Figure 1. An undergraduate education student created a visual representation of foundational literacy concepts in the form of a hot air balloon, including written justifications about why she selected specific parts of the balloon to represent particular literacy concepts.

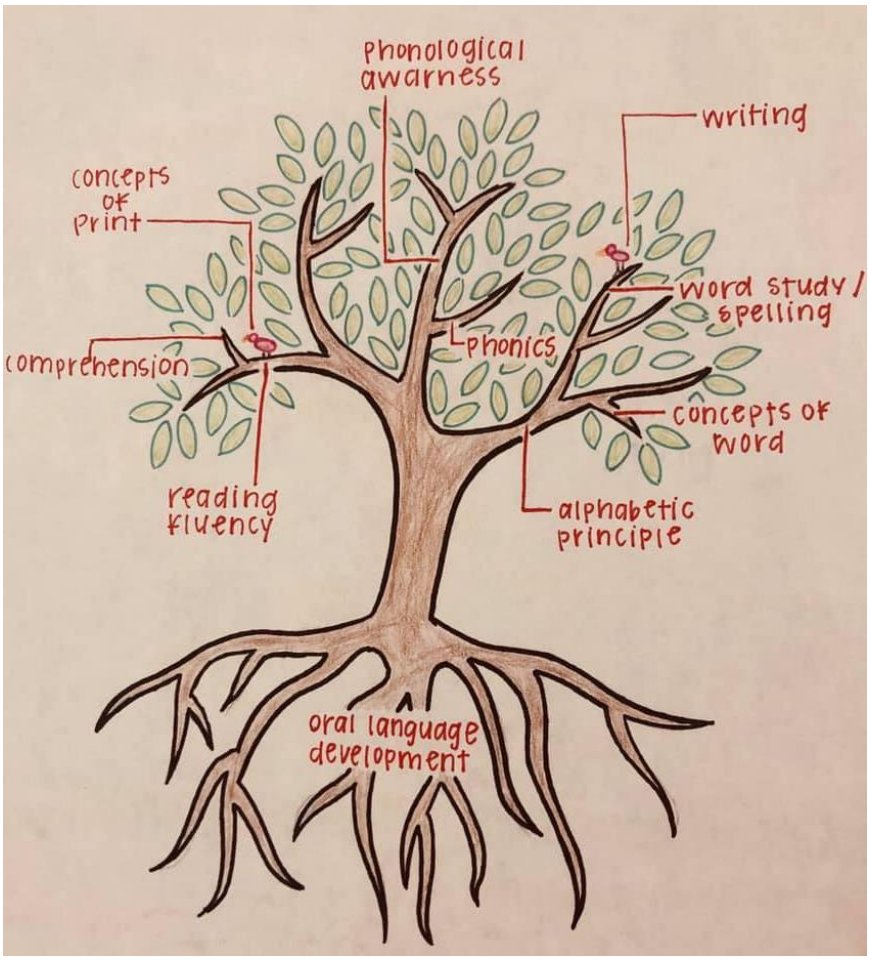


Figure 2. An undergraduate education student represented the interlinking of literacy concepts as a tree.

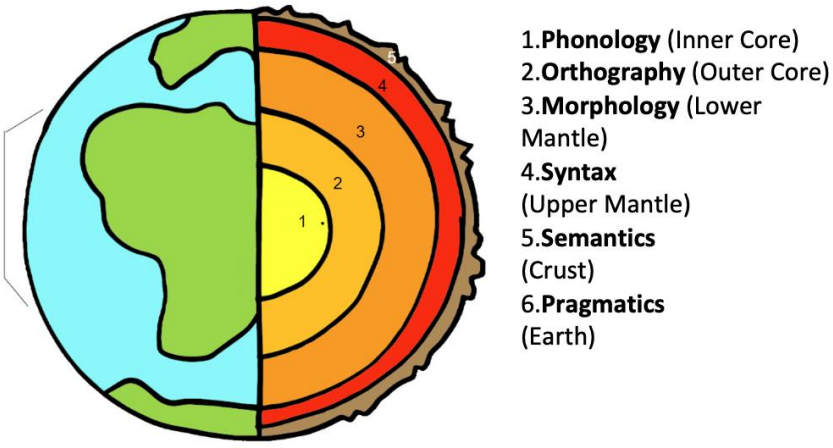
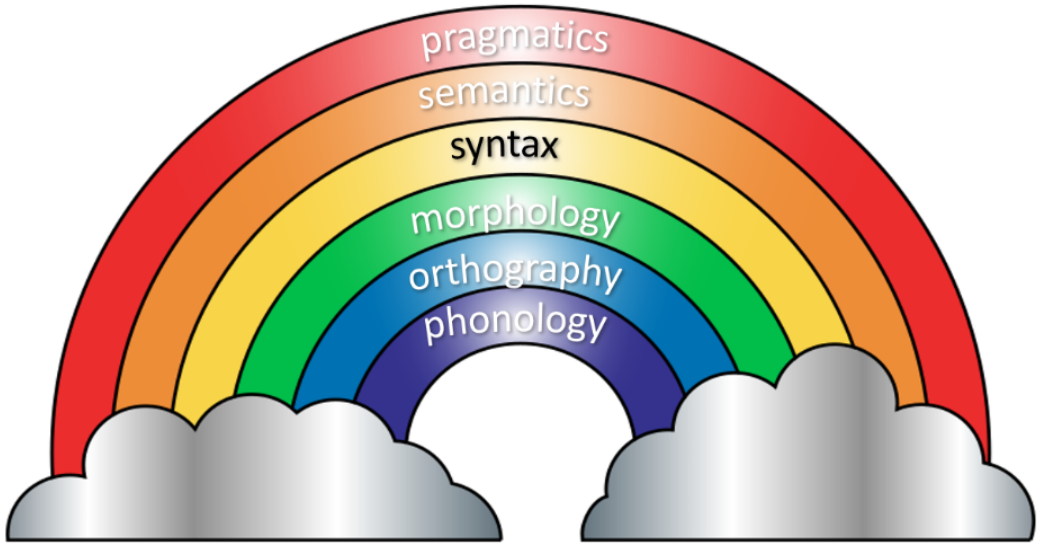


Figure 3. A graduate student depicted the components of oral language development as layers of the earth.



Components of Oral Language

I chose the color spectrum to represent the components of oral language. Violet light has the most energy therefore, I paired phonology with it to represent the importance of the foundation of oral language. Phonology is where "it all begins". The strength of one's phonological background determines the strength of future language. The wavelength of violet is short and the wavelength of red is long. This also represents how our ability to communicate grows in complexity as we progress through the components, and how our language skills widen and allow us to communicate in a broader sense. Lastly, the rainbow represents white light which is the present of all wavelengths showing that the colors are linked just as the components of oral language are linked.

Oral language begins with phonology (the sounds used to express language) therefore it is the foundation upon which the other components build. Orthography builds upon phonology because it takes what is oral and links it to written language. Morphology concentrates on how the word parts create meaning, taking the written word and truly being able to comprehend the words based on their parts. Syntax takes it from there where written words are combined into sentences and the must follow certain rules. Semantics takes syntax and adds the personal touch to spoken or written language. The experience component if you will. Lastly, pragmatics which enables us to communicate with one another and meet our individual needs. The component that reflects our cultures, background, and experiences.

Figure 4. A graduate student provided a written justification to explain how the elements of oral language development are equated to the complexities of colors in the rainbow.

By integrating and encouraging student creation of visual representations of complex concepts, these university education students were able to visually demonstrate the complicated and interwoven links and foundations of each of the literacy components. As educators, it is important to present new concepts and information in modes other than verbal (Beesley & Apthorp, 2010). By modeling the strategy of incorporating nonlinguistic and linguistic visual representations of course content and

concepts, students are also encouraged to show their knowledge and understandings in pictorial ways. The resulting visual creations have indicated strong student learning and deep conceptual understandings.

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